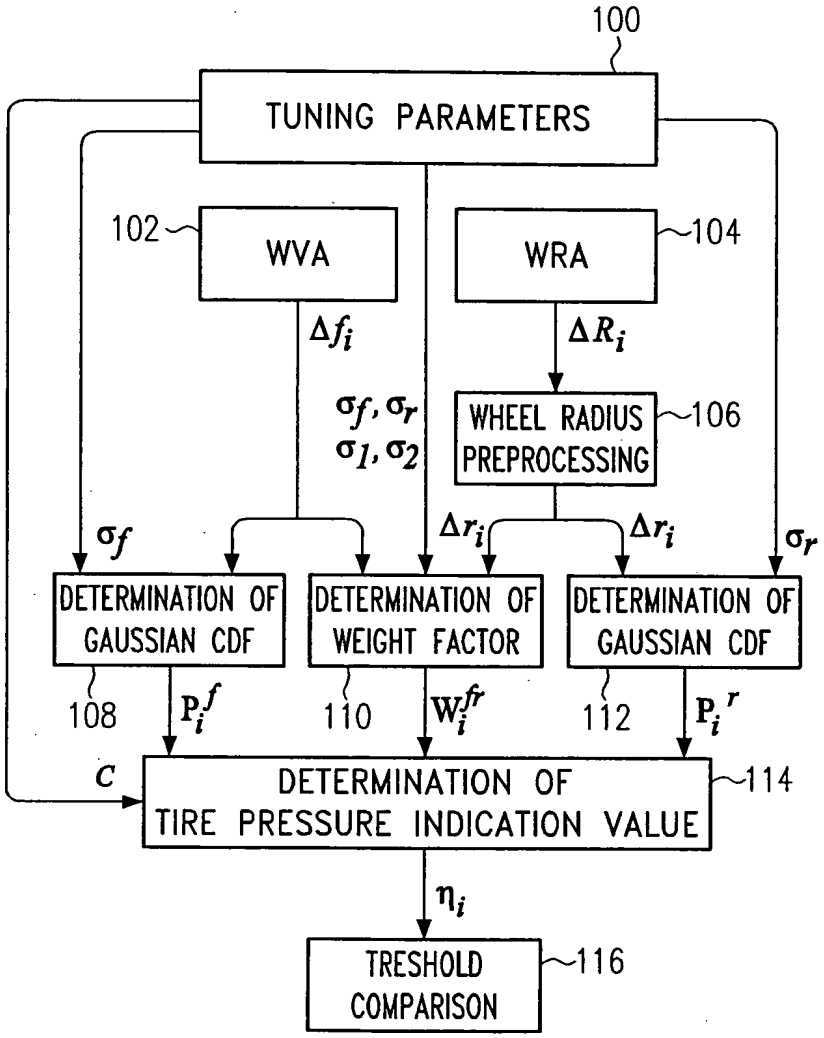

100
TUNING PARAMETERS
102
WVA
WRA
104
Δf_i
ΔR_i
σ_f, σ_r
σ_1, σ_2
WHEEL RADIUS PREPROCESSING
106
σ_f
Δr_i
Δr_i
σ_r
DETERMINATION OF GAUSSIAN CDF
DETERMINATION OF WEIGHT FACTOR
DETERMINATION OF GAUSSIAN CDF
108
P_i^f
110
W_i^{fr}
112
P_i^r
C
DETERMINATION OF TIRE PRESSURE INDICATION VALUE
114
η_i
TRESHOLD COMPARISON
116

Fig.1

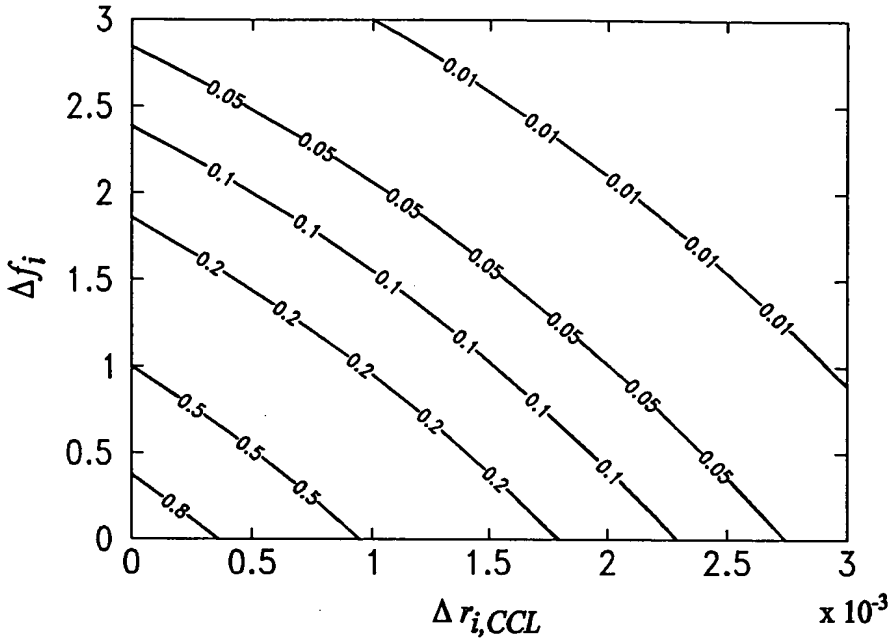


Fig.2A

(a) $\sigma_r = 1.4e-3$, $\sigma_f = 1.45$, $\sigma_1 = 0$, $\sigma_2 = 0.4$, $C = 4$.

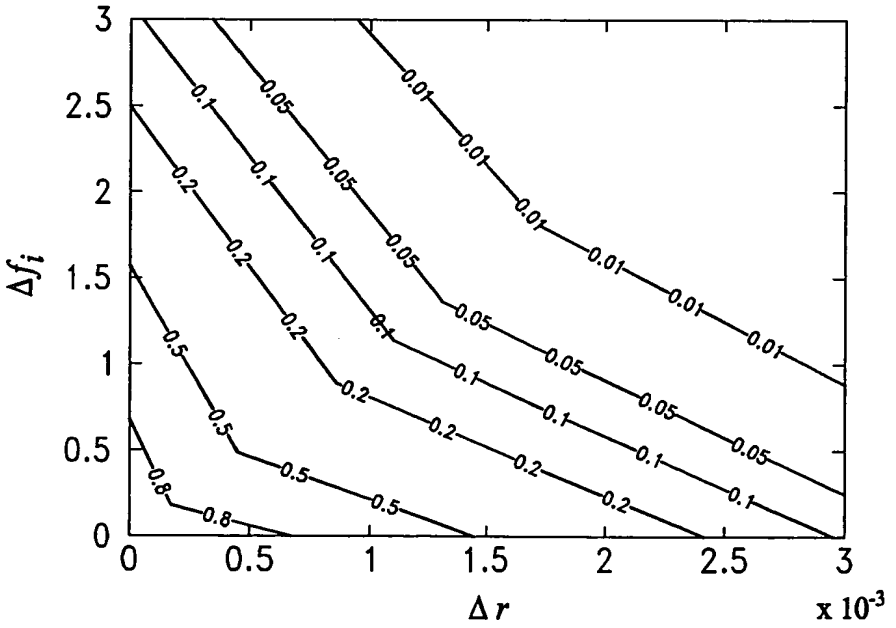
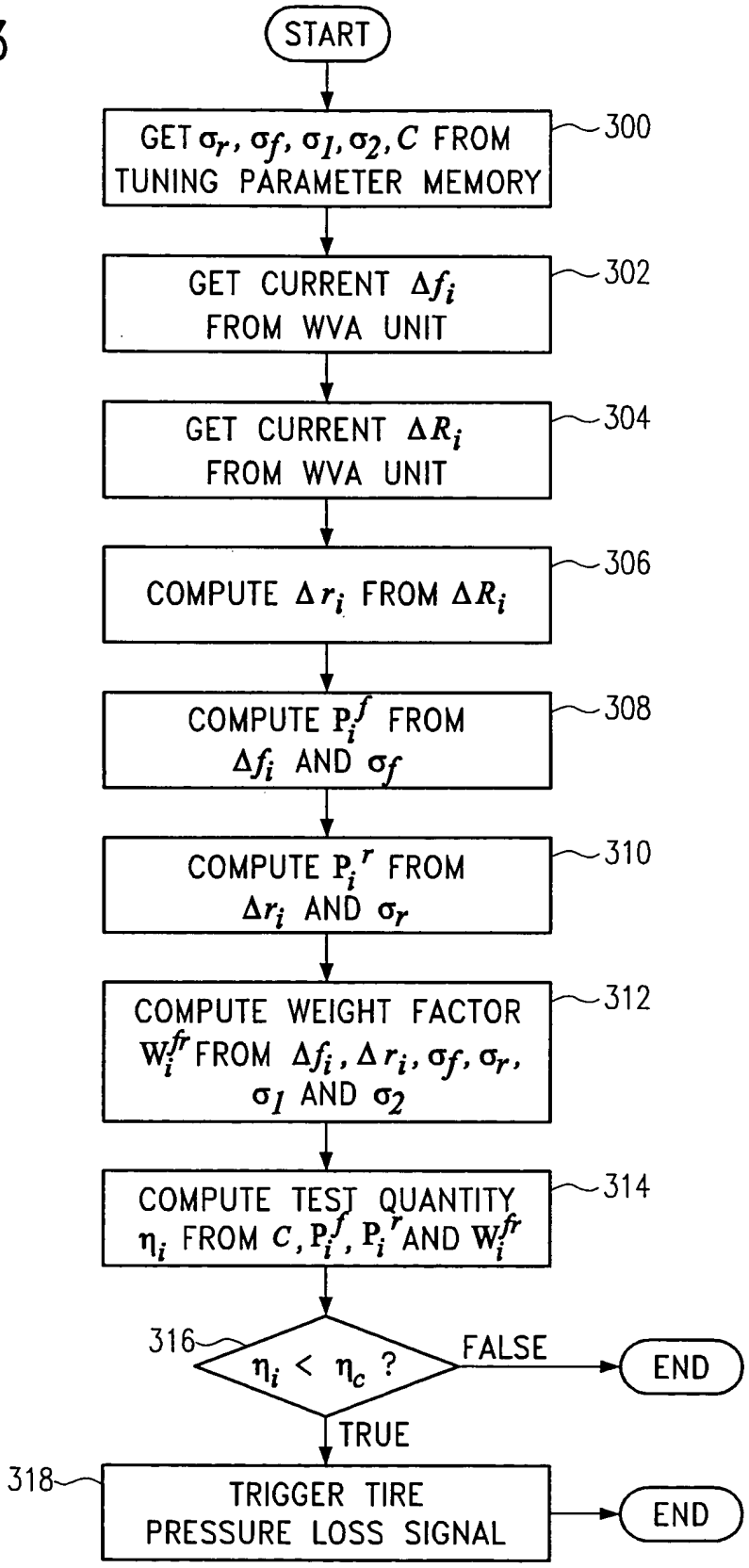


Fig.2B

(b) $\sigma_r = 1.4e-3$, $\sigma_f = 1.45$, $\sigma_1 = 0.5$, $\sigma_2 = 1$, $C = 4$.

Fig.3


START
GET σ_r, σ_f, σ_1, σ_2, C FROM TUNING PARAMETER MEMORY
300
GET CURRENT Δf_i FROM WVA UNIT
302
GET CURRENT ΔR_i FROM WVA UNIT
304
COMPUTE Δr_i FROM ΔR_i
306
COMPUTE P_i^f FROM Δf_i AND σ_f
308
COMPUTE P_i^r FROM Δr_i AND σ_r
310
COMPUTE WEIGHT FACTOR W_i^{fr} FROM Δf_i, Δr_i, σ_f, σ_r, σ_1 AND σ_2
312
COMPUTE TEST QUANTITY η_i FROM C, P_i^f, P_i^r AND W_i^{fr}
314
316
$\eta_i < \eta_c$?
FALSE
END
TRUE
318
TRIGGER TIRE PRESSURE LOSS SIGNAL
END

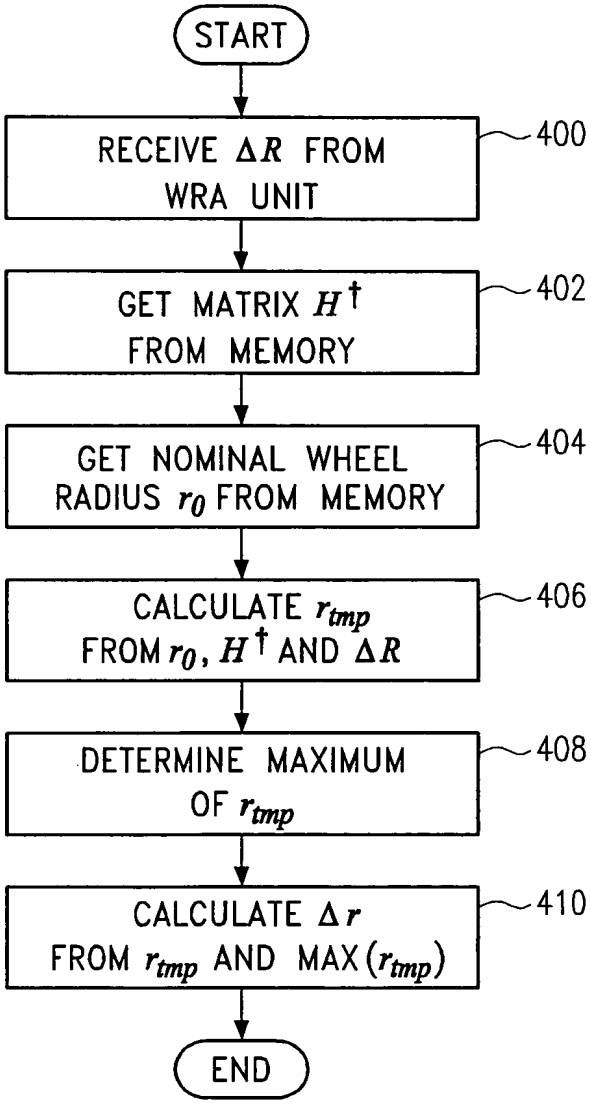

START
RECEIVE ΔR FROM WRA UNIT
400
GET MATRIX $H^{\dagger}$ FROM MEMORY
402
GET NOMINAL WHEEL RADIUS r_0 FROM MEMORY
404
CALCULATE r_{tmp} FROM r_0, $H^{\dagger}$ AND ΔR
406
DETERMINE MAXIMUM OF r_{tmp}
408
CALCULATE Δr FROM r_{tmp} AND MAX(r_{tmp})
410
END

Fig.4

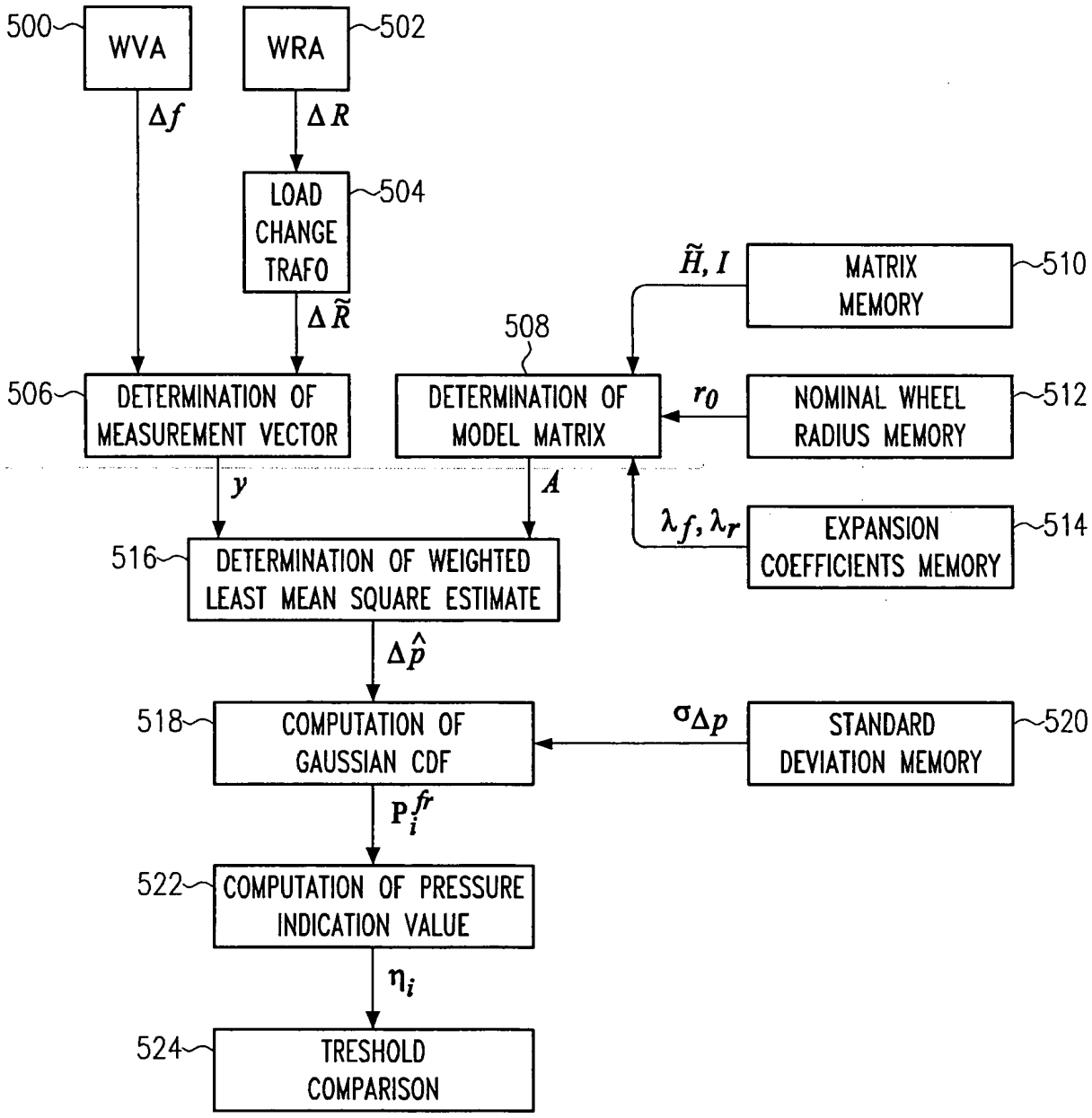

500
WVA
WRA
502
Δf
ΔR
LOAD CHANGE TRAFO
504
$\Delta \tilde{R}$
$\tilde{H}, I$
MATRIX MEMORY
510
508
506
DETERMINATION OF MEASUREMENT VECTOR
DETERMINATION OF MODEL MATRIX
r_0
NOMINAL WHEEL RADIUS MEMORY
512
y
A
λ_f, λ_r
EXPANSION COEFFICIENTS MEMORY
514
516
DETERMINATION OF WEIGHTED LEAST MEAN SQUARE ESTIMATE
$\Delta \hat{p}$
518
COMPUTATION OF GAUSSIAN CDF
$\sigma_{\Delta p}$
STANDARD DEVIATION MEMORY
520
P_i^{fr}
522
COMPUTATION OF PRESSURE INDICATION VALUE
η_i
524
TRESHOLD COMPARISON

Fig.5

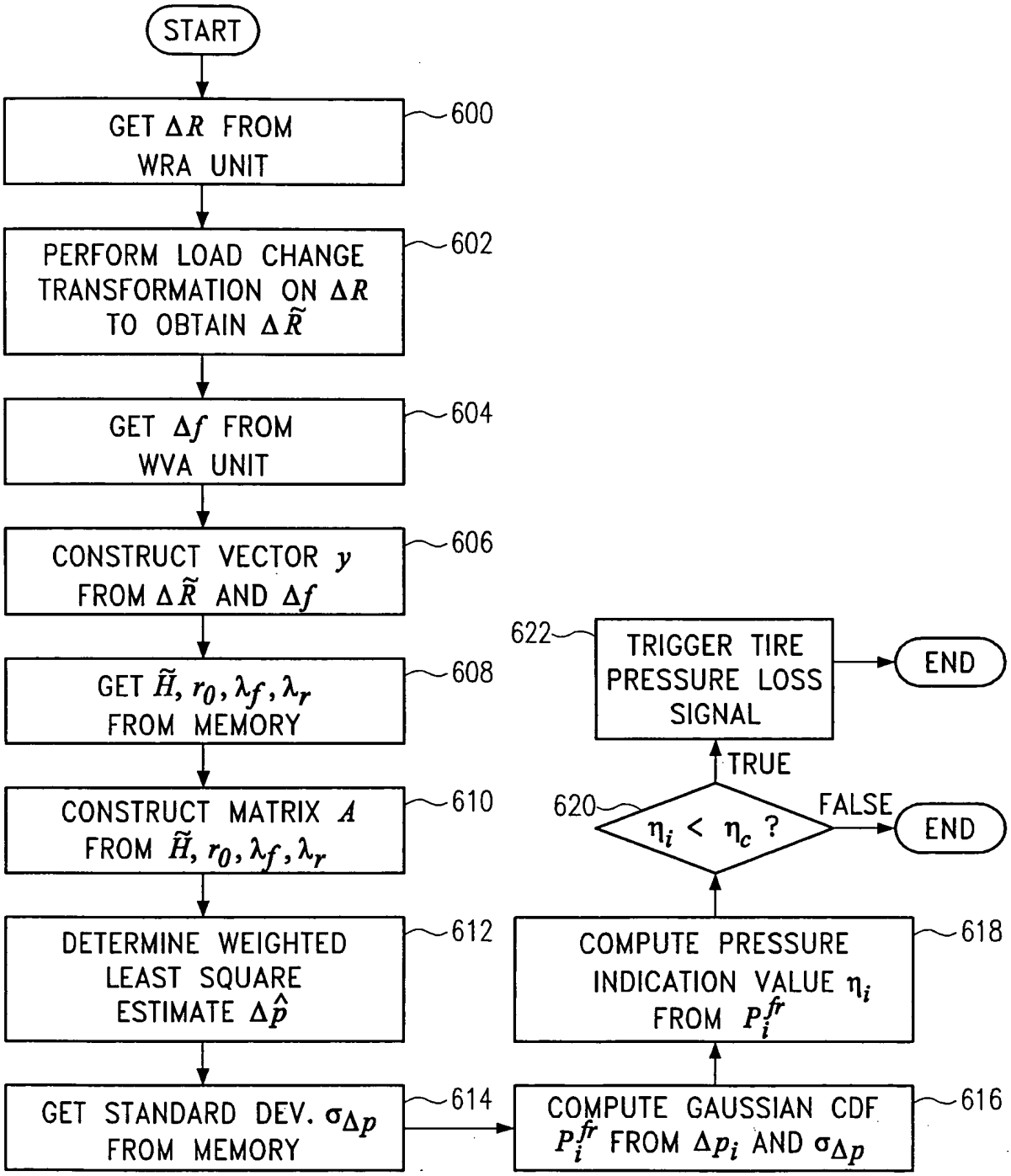

START
GET ΔR FROM WRA UNIT
600
PERFORM LOAD CHANGE TRANSFORMATION ON ΔR TO OBTAIN $\Delta \tilde{R}$
602
GET Δf FROM WVA UNIT
604
CONSTRUCT VECTOR y FROM $\Delta \tilde{R}$ AND Δf
606
GET $\tilde{H}, r_0, \lambda_f, \lambda_r$ FROM MEMORY
608
CONSTRUCT MATRIX A FROM $\tilde{H}, r_0, \lambda_f, \lambda_r$
610
DETERMINE WEIGHTED LEAST SQUARE ESTIMATE $\Delta \hat{p}$
612
GET STANDARD DEV. $\sigma_{\Delta p}$ FROM MEMORY
614
COMPUTE GAUSSIAN CDF P_i^{fr} FROM Δp_i AND $\sigma_{\Delta p}$
616
COMPUTE PRESSURE INDICATION VALUE η_i FROM P_i^{fr}
618
620
$\eta_i < \eta_c$?
TRUE
FALSE
END
622
TRIGGER TIRE PRESSURE LOSS SIGNAL
END

Fig.6

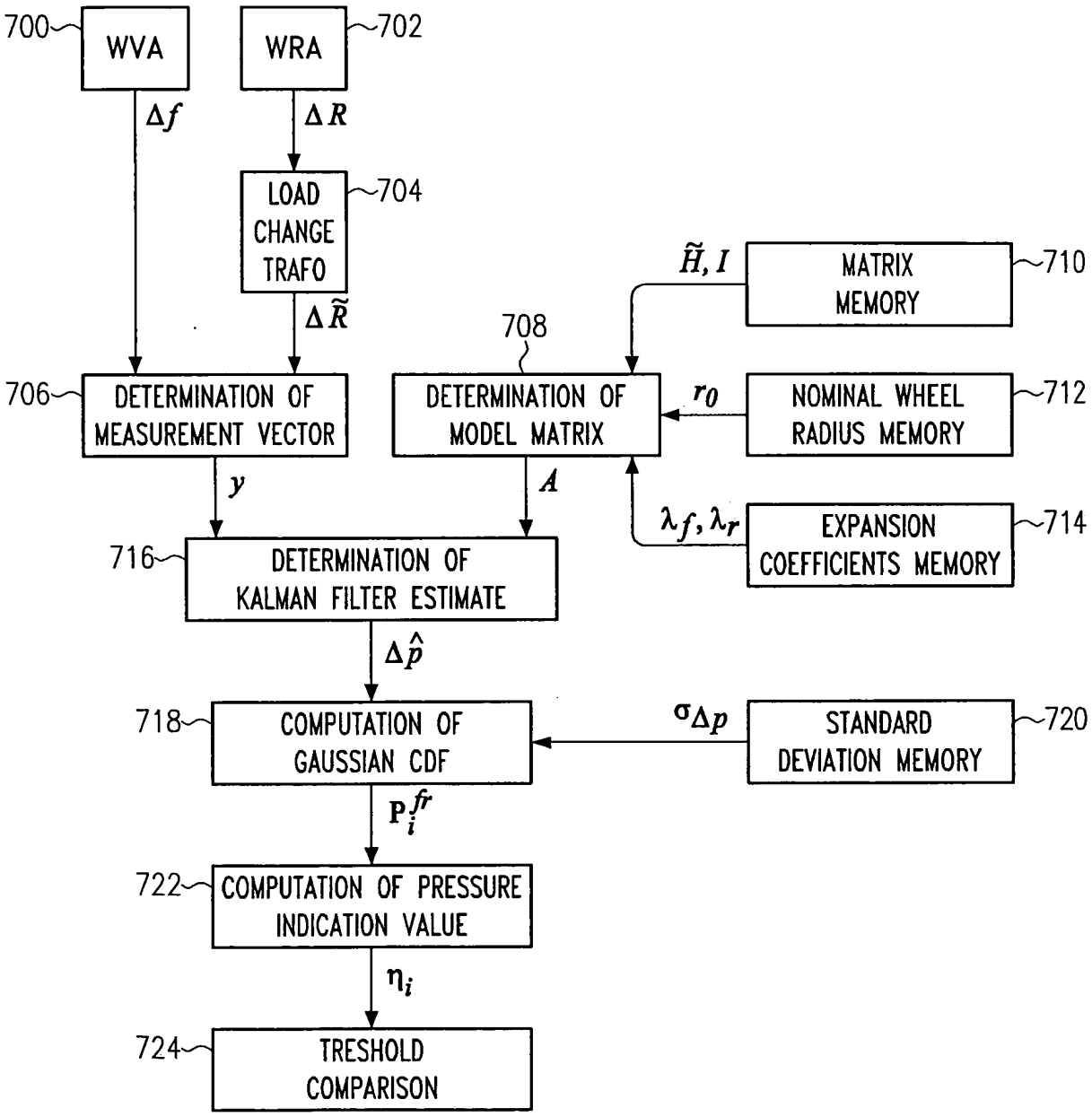

700
WVA
WRA
702
Δf
ΔR
LOAD CHANGE TRAFO
704
$\Delta \tilde{R}$
$\tilde{H}, I$
MATRIX MEMORY
710
708
706
DETERMINATION OF MEASUREMENT VECTOR
DETERMINATION OF MODEL MATRIX
r_0
NOMINAL WHEEL RADIUS MEMORY
712
y
A
λ_f, λ_r
EXPANSION COEFFICIENTS MEMORY
714
716
DETERMINATION OF KALMAN FILTER ESTIMATE
$\Delta \hat{p}$
718
COMPUTATION OF GAUSSIAN CDF
$\sigma_{\Delta p}$
STANDARD DEVIATION MEMORY
720
P_i^{fr}
722
COMPUTATION OF PRESSURE INDICATION VALUE
η_i
724
TRESHOLD COMPARISON

Fig.7

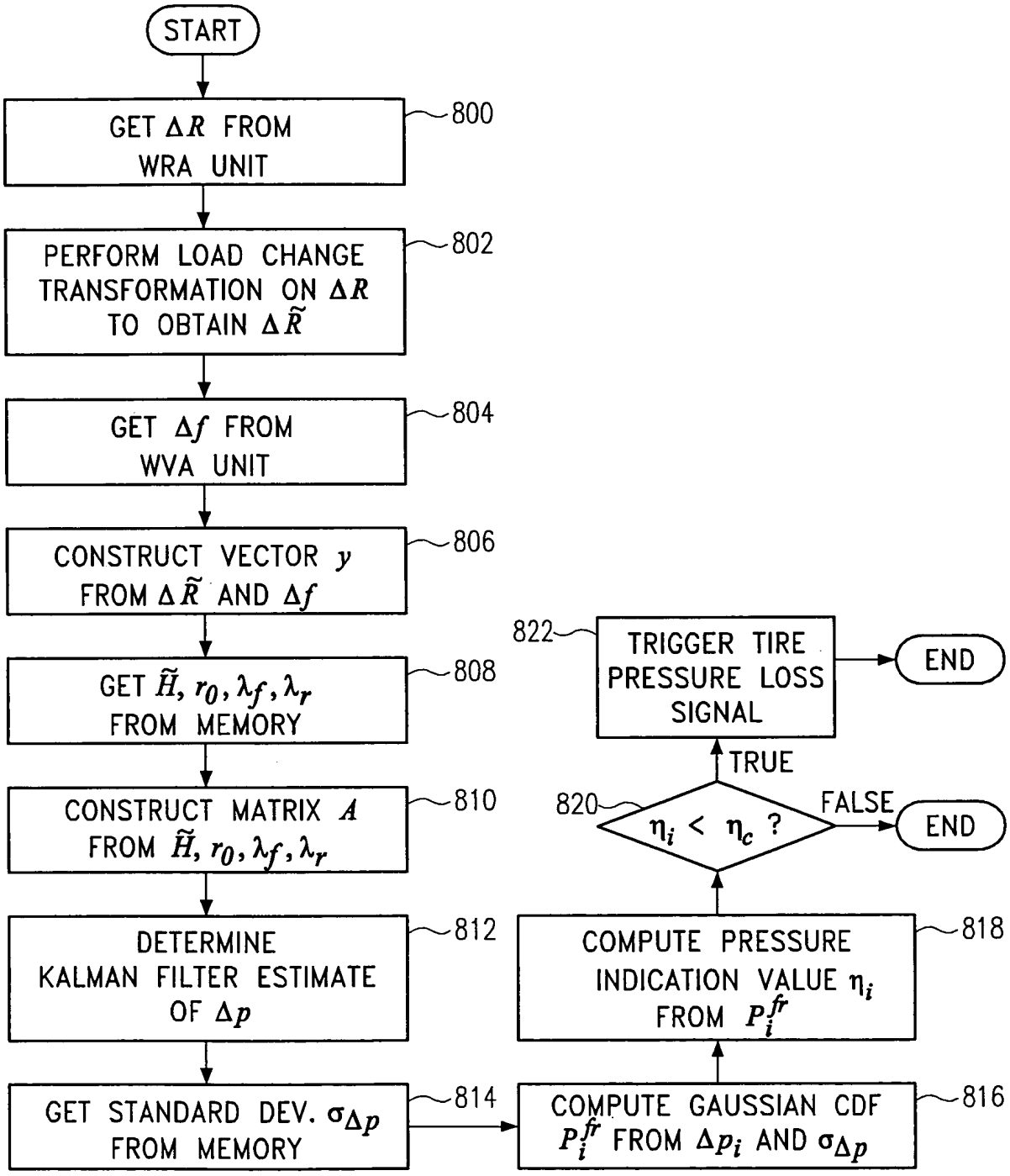

START
GET ΔR FROM WRA UNIT
800
PERFORM LOAD CHANGE TRANSFORMATION ON ΔR TO OBTAIN $\Delta \tilde{R}$
802
GET Δf FROM WVA UNIT
804
CONSTRUCT VECTOR y FROM $\Delta \tilde{R}$ AND Δf
806
GET $\tilde{H}, r_0, \lambda_f, \lambda_r$ FROM MEMORY
808
CONSTRUCT MATRIX A FROM $\tilde{H}, r_0, \lambda_f, \lambda_r$
810
DETERMINE KALMAN FILTER ESTIMATE OF Δp
812
GET STANDARD DEV. $\sigma_{\Delta p}$ FROM MEMORY
814
COMPUTE GAUSSIAN CDF P_i^{fr} FROM Δp_i AND $\sigma_{\Delta p}$
816
COMPUTE PRESSURE INDICATION VALUE η_i FROM P_i^{fr}
818
$\eta_i < \eta_c$?
820
TRUE
FALSE
END
TRIGGER TIRE PRESSURE LOSS SIGNAL
822
END

Fig.8

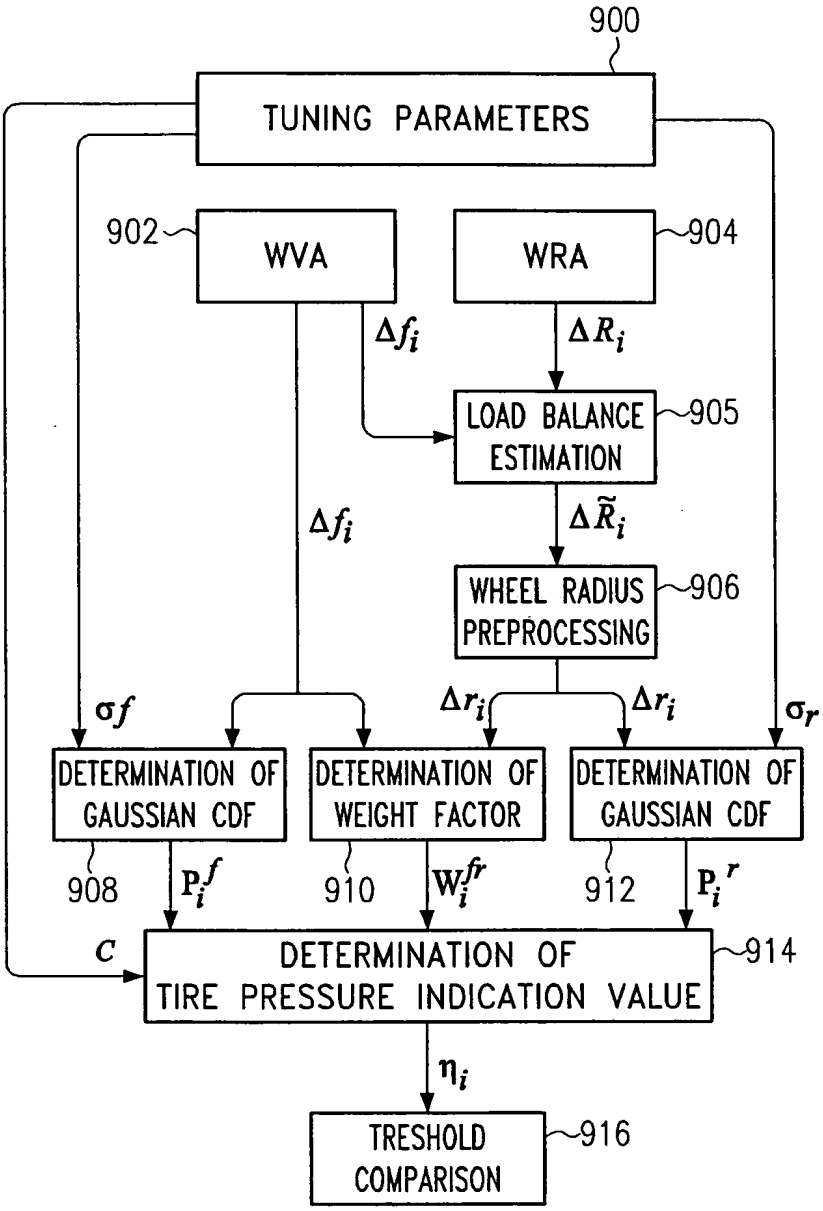

900
TUNING PARAMETERS
902
WVA
WRA
904
Δf_i
ΔR_i
LOAD BALANCE ESTIMATION
905
Δf_i
$\Delta \tilde{R}_i$
WHEEL RADIUS PREPROCESSING
906
σf
Δr_i
Δr_i
σr
DETERMINATION OF GAUSSIAN CDF
DETERMINATION OF WEIGHT FACTOR
DETERMINATION OF GAUSSIAN CDF
908
P_i^f
910
W_i^{fr}
912
P_i^r
C
DETERMINATION OF TIRE PRESSURE INDICATION VALUE
914
η_i
TRESHOLD COMPARISON
916

Fig.9

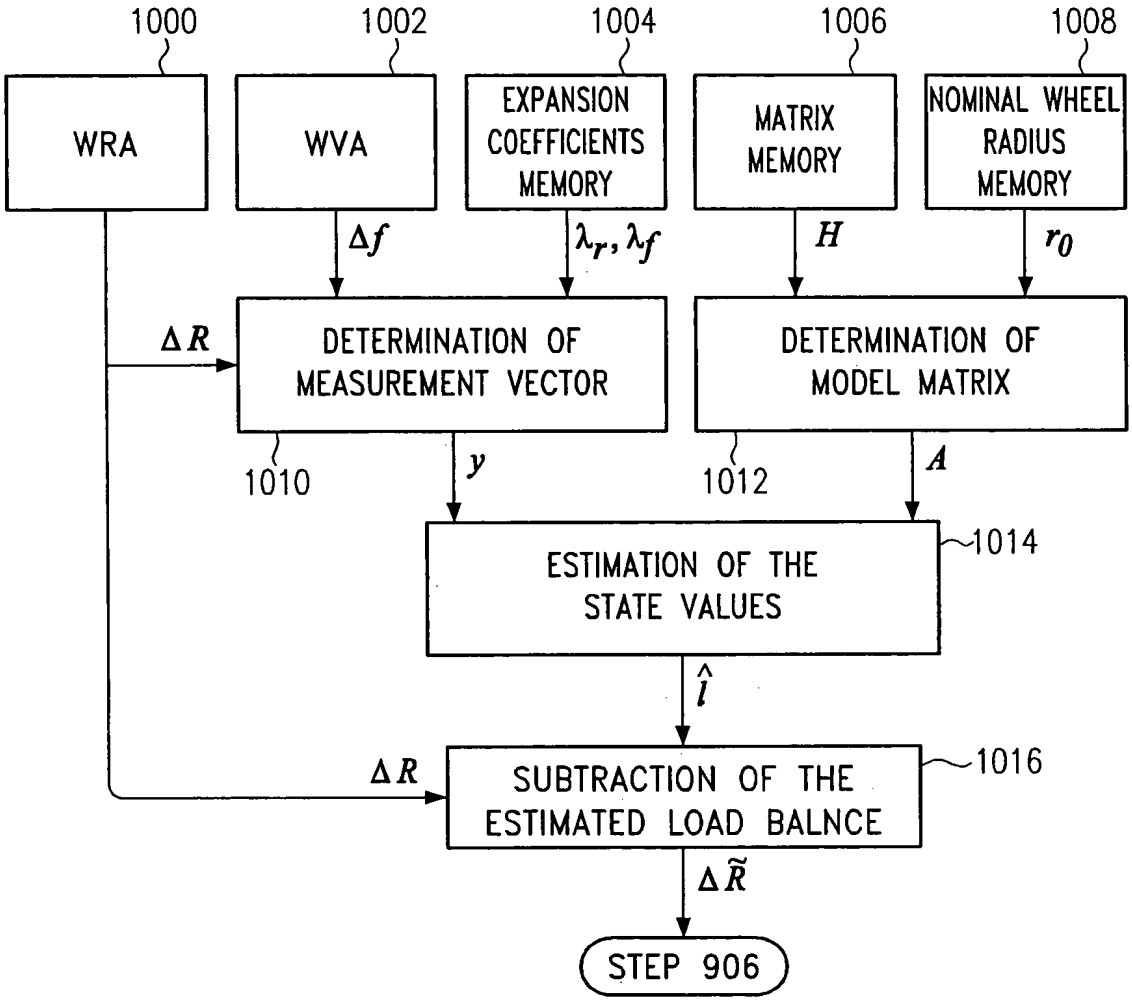

1000
1002
1004
1006
1008
WRA
WVA
EXPANSION COEFFICIENTS MEMORY
MATRIX MEMORY
NOMINAL WHEEL RADIUS MEMORY
Δf
λ_r, λ_f
H
r_0
ΔR
DETERMINATION OF MEASUREMENT VECTOR
DETERMINATION OF MODEL MATRIX
1010
y
1012
A
ESTIMATION OF THE STATE VALUES
1014
$\hat{l}$
ΔR
SUBTRACTION OF THE ESTIMATED LOAD BALNCE
1016
$\Delta \tilde{R}$
STEP 906

Fig.10

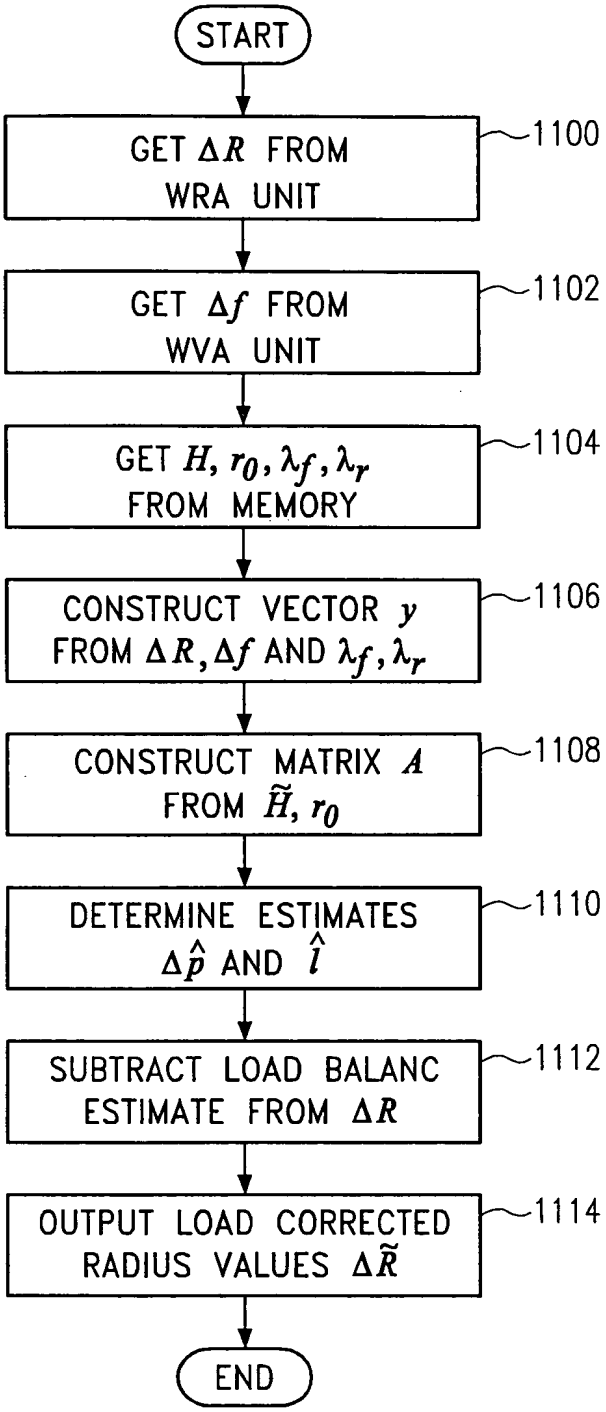

START
GET ΔR FROM WRA UNIT
1100
GET Δf FROM WVA UNIT
1102
GET $H, r_0, \lambda_f, \lambda_r$ FROM MEMORY
1104
CONSTRUCT VECTOR y FROM $\Delta R, \Delta f$ AND λ_f, λ_r
1106
CONSTRUCT MATRIX A FROM $\tilde{H}, r_0$
1108
DETERMINE ESTIMATES $\Delta\hat{p}$ AND $\hat{l}$
1110
SUBTRACT LOAD BALANC ESTIMATE FROM ΔR
1112
OUTPUT LOAD CORRECTED RADIUS VALUES $\Delta\tilde{R}$
1114
END

Fig.11

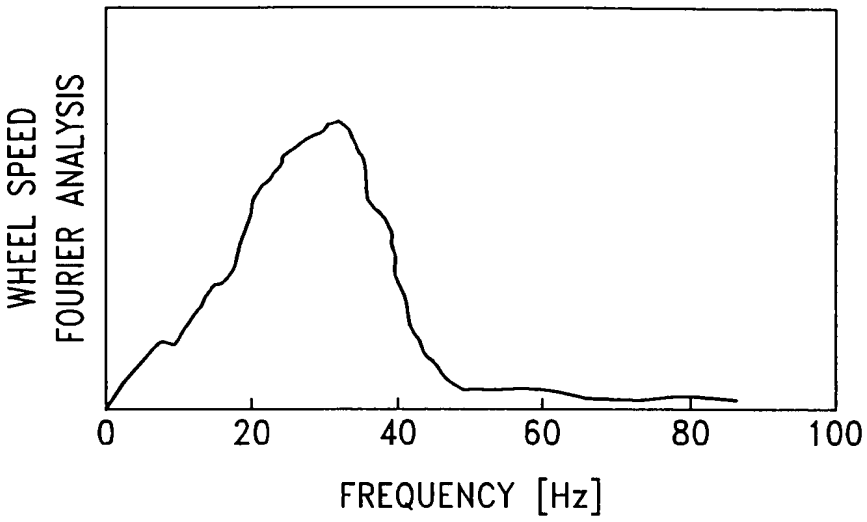


Fig.12A

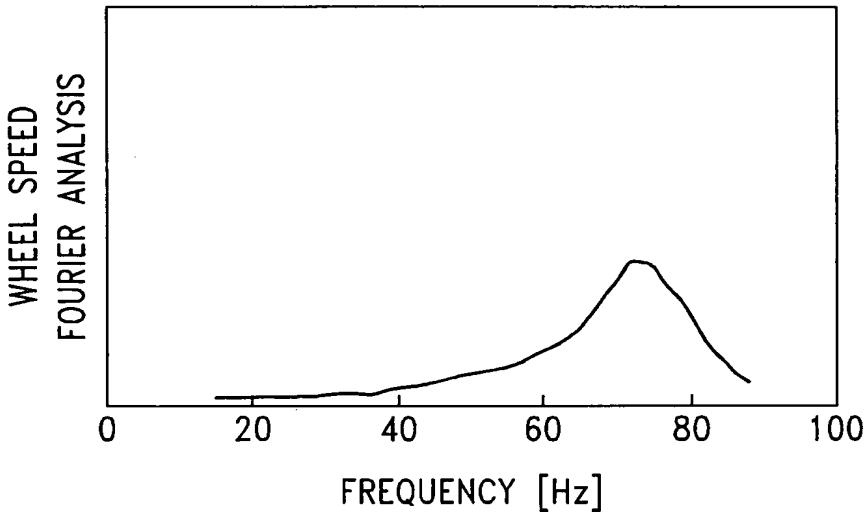


Fig.12B

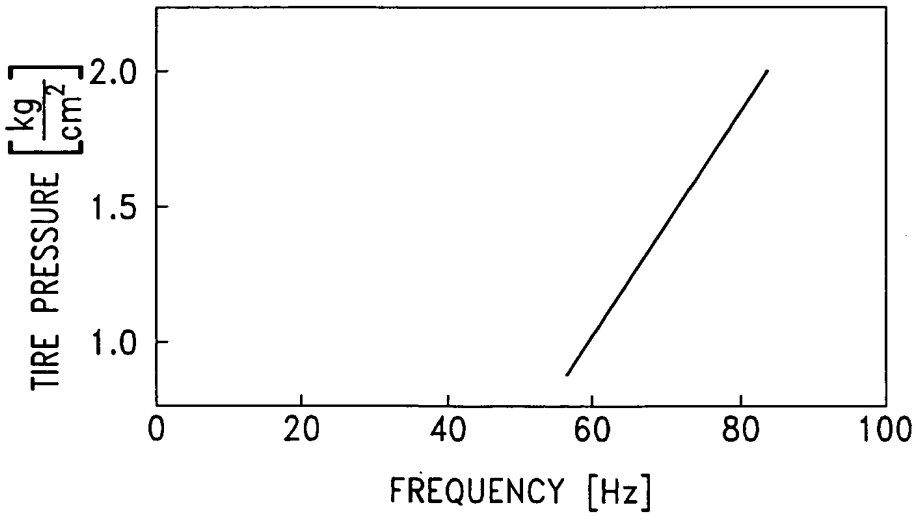


Fig.13

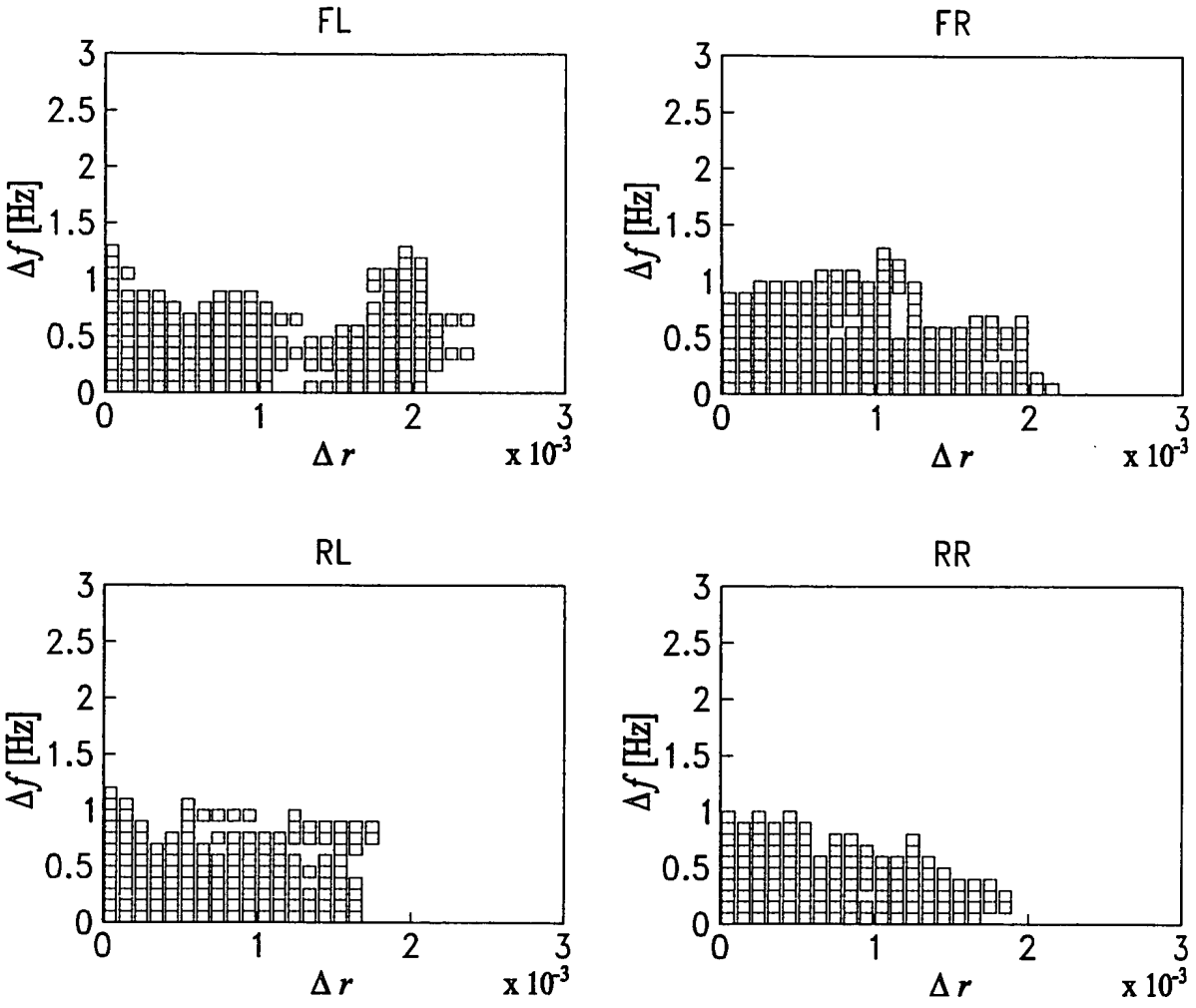


Fig.14